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SEASONAL-SCALE OPTIMIZATION OF CONVENTIONAL HYDROPOWER OPERATIONS IN THE UPPER COLORADO BASIN

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The world is facing many challenges in meeting the growing energy demand. Concerns about water quality, climate change, and energy independence have led to increased interest in renewable energy, including hydroelectric power. Advanced analysis is needed to increase the efficiency of hydropower generation while dealing with environmental and other water resources issues. Sandia National Laboratories is creating the Hydropower Seasonal Concurrent Optimization for Power and the Environment (HydroSCOPE) tool, a systems-level hydropower simulation and optimization tool that couples a water quality model of reservoir and river systems with optimization software to perform tradeoff analysis for seasonal-scale hydropower operations. A coarse-grained representation of the hydrologic and energy characteristics of the reservoirs and rivers within a basin is used to simulate seasonal-scale hydropower operations. Based on the optimization routines from Sandia's DAKOTA (Design Analysis Kit for Optimization and Terascale Applications) software, we explore different optimization strategies tailored to maximize revenue from power generation while complying with or exceeding environmental requirements and other operational concerns.

This study focuses on the application of HydroSCOPE to a six-reservoir system in the Upper Colorado River Basin. A multi-objective optimization strategy is used to explore various operational approaches that will allow improvement in both revenue generation and environmental goals, while a capability for single-objective optimization makes the tool integrable with short-term planning models. The HydroSCOPE tool is part of an integrated, multi-laboratory project designed to explore different aspects of optimizing conventional hydropower operations. This seasonal-scale tool will be integrated with other components of this project, which include day-ahead planning, environmental performance, hydrologic forecasting, and plant efficiency.

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